CONFIDENTIAL

7 May 1976

MEMORANDUM FOR: [redacted] 25X1A
Executive Officer, Intelligence
Community Staff

SUBJECT : MEAP Panel Report

A—,

1. The DCI's Military Economic Advisory Panel has provided Ed Proctor a paper with thoughts and recommendations on ways CIA and the Community might improve US understanding of the Soviet RDT&E process and the resources devoted to it. I attach two copies for your information and reaction. The Panel will meet next in mid-June. Among other things, the Panel will discuss the issues and suggestions raised in this paper--and our reaction to them. 25X1A

2. There are broad Community aspects to the problem discussed in the Panel paper and the suggestions offered. Please let me know if the Intelligence Community Staff has any thoughts to offer on the subject.

[redacted] 25X1A
Acting Director
Strategic Research

Attachment:
MEAP Report (2)

OSD REVIEW COMPLETED

25X1

WARNING NOTICE
SENSITIVE INTELLIGENCE SOURCES
AND METHODS INVOLVED

CONFIDENTIAL

[redacted]

7 April 1976

Dr. Edward W. Proctor
Deputy Director for Intelligence
Central Intelligence Agency
Washington, D. C. 20505

Dear Ed:

I attach for your consideration the Panel report on ways CIA might improve its analysis of Soviet RDT&E policies and resources. The report has been vetted with all Panel members and their views incorporated into the paper, but we have not met as a group to discuss the report. There are no dissenting views among the Panel members on the thrust of the paper or on the recommendations, but we may wish to elaborate on some aspects after our next meeting.

I would like, therefore, to hold open the option of reviewing the question again at our next full Panel meeting where we will have an opportunity to obtain your reaction to the paper and the Panel will be able to sit around the table and discuss further issues that might be raised. In any event we will want to look at the question again some few months after you have set in motion whatever steps you decide to follow.

[redacted] 25X1A

Chairman
Military-Economic Advisory Panel

Enclosure:
As Stated

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REPORT OF THE MILITARY-ECONOMIC ADVISORY PANEL ON ESTIMATES OF SOVIET MILITARY RDT&E POLICIES AND RESOURCES

28 April 1976

NOTE: This report was prepared in the first instance by one Panel member-[redacted]-who conducted the interviews and the survey of past studies of Soviet RDT&E policies and resources which form the basis for the findings, and who prepared the initial draft. While the other Panel members did not personally look into the matter in as great detail, and while the Panel did not meet to discuss the report, all members of the Panel were individually consulted on the draft and their views have been incorporated in the text of the report. All members of the Panel support the course of action recommended.

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REPORT OF THE MILITARY-ECONOMIC ADVISORY PANEL ON ESTIMATES OF SOVIET MILITARY RDT&E POLICIES AND RESOURCES

SUMMARY

The Panel has looked more closely into its earlier assertion that the Agency's basis for estimating Soviet resources devoted to military RDT&E is deficient. We have scrutinized previous Agency work as well as analyses conducted elsewhere in Government and private institutions, and we have interviewed numerous intelligence managers and analysts, as well as consumers of the end-product. Our principal conclusions:

--We reaffirm our prior view that additional analytical efforts are needed to bolster the credibility and narrow the uncertainty surrounding CIA estimates of the size and composition of the Soviet RDT&E effort. We suggest a concentrated effort on bench-mark years--at least at the outset.

--We continue to believe that a broader all-source analytical attack is needed to avoid dependence on just one body of data--Soviet financial information. In particular, we feel that studies of RDT&E resources should be supplemented by studies of overall Soviet goals, policies, development styles and decision processes. Intelligence specialists and consumers alike tended to agree, but all were not equally sanguine about the confidence or level of detail that could be achieved through such analysis.

--Past efforts along multi-disciplinary lines have not met with great success. This is due partly, we think, to the fact that individual portions of the work were conducted under differing viewpoints and objectives, without a unified work program. Also, national intelligence priorities have been directed more to the nearer term threat of deployed Soviet forces and to the developing technologies soon to enter those forces than than to the longer term aspects of the US Soviet competition in science and technology.

As we see it, the analytical effort invested by CIA could be augmented at three different levels, depending on the goals sought.

For example, if the goal is limited to developing a more defensible and persuasive quantitative estimate of the aggregate size of the effort--but without underlying definitional detail--the addition of two to three analysts would probably be sufficient. This effort would focus on budget, manpower, and institutional financial practices.

If, on the other hand, the Agency were also to seek to illuminate the underlying trends, technological priorities and bureaucratic processes, a more intensive study would be required. This would include additional detailed consideration of the resource trends in physical facilities and individual RDT&E programs, as revealed largely by technical collection programs, along with studies of the institutional environment within which Soviet science policy is decided and implemented. Such an effort would be manpower intensive, and we see two alternative approaches:

--First, a totally in-house CIA effort--conducted jointly by the DDI and DDS&T--could be initiated. The bulk of the effort in resource calculations would fall on the DDI (OSR). The start-up costs of this approach would be sizeable--perhaps 15-20 full-time analysts--unless the payoff period were stretched to a couple of years or so.

--A less costly option would draw on community assets already engaged in directly related work. The Agency augmentation could be on the order of 6-7 analysts working through existing mechanisms--such as the Science Policy and Resources Advisory Group of the Scientific and Technical Intelligence Committee.

On balance, the Panel favors the last approach. Such a community-wide effort would require close agreement on concepts and definitions and in fully shared goals by the participating agencies. Details are included in the accompanying text.

REPORT OF THE MILITARY-ECONOMIC ADVISORY PANEL ON ESTIMATES OF SOVIET MILITARY RDT&E POLICIES AND RESOURCES

Introduction

In its second report, CIA's Military-Economic Advisory Panel commented critically on the Agency's monetary measures of Soviet RDT&E and on the use of these estimates in comparison with similar US data. It might be useful at the outset to summarize the Panel's main points. In brief:

--Time has run out on CIA's ability to depend exclusively on Soviet budgetary data to estimate the aggregate level of effort of Soviet RDT&E.

--No other single methodology seems likely to be a satisfactory alternative, and it is even possible that no combination of techniques will yield an annual single-valued time series of Soviet ruble outlays or comparable US dollar costs that can be advanced with very great confidence.

--But given the high level of consumer interest, the Agency should seek to develop a more comprehensive analytical basis for its studies of Soviet R&D and should place this task high on its list of priorities. It is at least as important, we think, to understand Soviet aims, patterns of choice, and development style as to try to achieve simply a more reliable--but purely quantitative--estimate of resourves going into Soviet RDT&E. Moreover, improved outlay estimates may emerge as a by-product of additional research on organization and operation.

--Meanwhile, the Agency should only provide ruble and dollar valuations of Soviet military RDT&E separately from its monetary measures of other Soviet military activities and programs and emphasize the higher level of uncertainty of the R&D measures. There was even considerable sentiment favoring total cessation of publication of monetary measures of RDT&E until a much improved methodology has been developed.

Discussion

The Deputy Director for Intelligence and the Director of Strategic Research indicated general agreement with the thrust of the criticism, and asked the Panel to examine in somewhat greater detail alternative analytic approaches, including those that have been or are now being used by others in the community, in private research organizations, and in academic institutions, and to suggest courses of action they might take. This paper responds to that charge.

The Study Approach

The basis for this paper is a review of the major analytic efforts of the past few years to examine overall Soviet military RDT&E policies and resources, along with interviews of numerous intelligence managers and analysts familiar with the problem. Selected national level users of the end-product who are now, or have been, engaged in planning US RDT&E priorities and budgets were also consulted. The objective was to determine the attitudes and beliefs of those most directly sensitive to the sword point of the problem of evaluating the Soviet commitment to science; to consider the needs of consumers and their

priorities for additional work; and to look for existing work and community coordinating mechanisms that could be exploited in the interests of improving CIA's work on Soviet science policy and resources. The frame of reference of the study was restricted to the economic resources engaged in RDT&E, and the Soviet institutions which plan and direct the application of those resources. Explicit consideration of Agency or community work on specific Soviet weapons technologies was excluded from our review.

Although the issues covered in this paper were discussed in detail with a number of government officials and knowledgeable private parties, they are not responsible for any of the findings. We do not believe, however, that these findings are seriously in conflict with the dominant views of our correspondents.

In the discussion we cover topics that are well known to most analysts and managers who have worked on Soviet RDT&E, but we wished to provide a paper whose utility might also extend to those less familiar with the subject.

Looking Backward

Over the years--and particularly since the late 1960s--numerous studies have been produced within and outside the government that have attempted to measure, describe, and analyze trends in Soviet military RDT&E using one or more of the principal information sources: financial data, statistics on S&T manpower, observed physical facilities and programs, and the official organizations engaged in R&D. Much of this work has gone on outside of CIA, principally at the Institute for Defense Analysis (IDA) and the RAND Corporation--under contract to the Department of Defense--and at DIA, the Foreign Science and Technology center (FSTC) of the Army, and the Foreign Technology Division (FTD) of the Air Force.

There is wide variation in the scope and objectives of the various studies, in the concepts and definitions of RDT&E that are used, and in the results obtained--and this has discouraged attempts to utilize the work already done for further integrative studies. With one exception--NIE 11-12-72, Soviet Military Research and Development--CIA has not seriously tried to exploit the body of work done externally to it to try to develop aggregate resource measures and their underlying detail. And even

that NIE itself was far from euphoric about the results. These are the words:*

> "The conventional way to represent the resources available for military R&D and space programs--e.g., the research institutes, test facilities, manpower, and other inputs--is by means of the total expenditures involved. There are, however, no data that permit this to be done for the USSR in a reasonably straightforward fashion. Soviet financial data from official Soviet publications, and the detailed but incomplete information on Soviet facilities and programs . . . must be supplemented with a large amount of indirect data, subsidiary judgments, extrapolations, and assumptions to derive an estimate. There is no way of confidently telling how much error is introduced by each step in the process or whether, and to what extent, the errors offset one another or cumulate.
>
> Even if the accurate estimate of expenditures for Soviet military R&D plus space programs could be derived, expressing it in terms permitting useful comparison with similar US expenditures is fraught with further problems. The US and the USSR have different currencies, economic priorities, price structures, institutional approaches, strategic goals, military tactics, and technical traditions--to mention only a few areas of difference. And even if R&D expenditure estimates in the US and USSR were expressed in a common currency, the comparison could still only be used in the most general fashion as a gross measure of the relative effort. Moreover, an equal input of money does not imply an equal military achievement or capability."

Subsequent CIA avoidance of further attempts of this sort may stem in part from the reservations expressed in

* Authorization to use this quote at the OUO level was obtained from the Acting NIO for Strategic Forces.

that document, but other factors also appear to have contributed. For example:

--An increased workload had developed in the Agency and the Community because of the need for more detailed analyses of the deployed forces, and consumer emphasis on specific technology-oriented R&D studies. SALT and MBFR negotiating and monitoring requirements loomed large in this.

--The principal consumer for broader evaluation of R&D policies, priorities, and resources--the DDR&E--did not actively dissent from the existing CIA estimates of aggregate Soviet resources devoted to military RDT&E, and in fact used them extensively. In the absence of program-related definitional detail (in resource terms) in the CIA estimates, the DDR&E turned largely to sources it could task more directly--its contractors and DoD components.

--The pressures felt individually by Agency S&T components and military-economic components thus did not seem to call urgently on the DDI and the DDS&T to make common cause on the overall problem of RDT&E policies and resources.

--And at the level of analytical resources CIA devoted to the problem, the Agency was not even in position to evaluate or digest the results produced elsewhere or to try to influence that work to make it more useful in advancing its own.

We believe--from conversations within the Agency --that all that has been said above will accord fairly well with views now held by most CIA production managers and analysts who are familiar with the problem. Thus,

in our view it will take no marked departure from present attitudes--but only changes in practices and committed resources--for the Agency to test the hypothesis that a sustained and comprehensive effort on Soviet RDT&E policies, resources, and institutions will be worth the candle.

And we want to be clear that it is still a hypothesis. A sustained, serious, and comprehensive attack on this problem will take manpower that could be well-applied to other tasks, and the results of the work will--as the NIE cited points out--always remain less precise than one would wish. But the alternative, in our view, is to abandon the field of military R&D resources altogether and to forgo whatever gains in illuminating long range programatic or technology-related trends and priorities that might be had from a multi-faceted study of R&D resource flows and the institutions through which they are employed.

The Issues

The question of the need for CIA to augment its efforts on Soviet science policy and resources can be reduced to the following subordinate issues.

--Who are the principal consumers of the end-product; what do they need; and at what priority?

--What are the principal deficiencies in the work now being done?

--What are the alternatives and prospects for improvement?

--Having selected a course of action--given the competing priorities for manpower--what work program and staffing should be followed?

Consumers' Needs and Priorities

Although the entire US national security planning and decision-making apparatus is in a sense the consumer of intelligence on Soviet science policies and resources, it is the Director, Defense Research and Engineering (DDR&E) who has been viewed as the principal agent for articulating intelligence needs in this area.

As indicated in an earlier section, the DDR&E has placed a greater reliance in recent years on individual DoD components and external contractors than on the National Intelligence process to meet his needs. For example, there is at this time no formal statement of

a national priority (at the level of the former USIB) for studies of the broader issues in Soviet science policies and resource allocations and no Key Intelligence Question (KIQ) addresses the subject. Whereas several National Intelligence Officers (the NIOs for Economics, Strategic Forces, and Theatre Forces) have cognizance over some aspects of Soviet R&D, none has a responsibility for following Soviet science and technology as a whole.

At the departmental intelligence level--within the Department of Defense--a somewhat different situation exists. The Director, Defense Research and Engineering has over the years steadily sponsored external research and encouraged work within DIA and the military service intelligence agencies on the overall analysis of Soviet military RDT&E as a process and an important aspect of Soviet and US competition. Moreover, last year the Defense Science Board identified a key defense requirement for the study of the overall strategy, institutional process, and resources for the Soviet military R&D establishment. The stated goal was for the development of a model of the Soviet R&D process which would integrate data on the substance of Soviet military programs--as evidenced by physical activity--with information on

the organizational and bureaucratic aspects of the system and the economic resource levels which support it. In the words of the Defense Science Board, the potential is as follows:

> "The impact of intelligence that improved our picture of the Soviet R&D process is potentially far reaching. While such intelligence should not be expected to influence immediate program choices or weapons acquisition decisions, it would over time have several important indirect effects. First a more precise and thorough synthesis of the Soviet military R&D system would assist us in broadly determining the level and distribution of our R&D efforts. Second, the intelligence could be influential in the U.S. techbase effects, suggesting scientific and technical areas that should be either more vigorously pursued or where emphasis should be reduced. Most importantly this intelligence approach would assume that we were taking an adequately long-term and objective view of our adversaries technical capability, productivity, and scientific interests."

The study was careful to say, however, that the prospects for success were not certain:

> "Of course, the time horizon of interest in this VIQ* extends into the indefinite future; resources should be committed to this effort up to a point where a sufficiently detailed picture of the Soviet military R&D system is formed to permit an assessment of the value of this approach. There has been some useful attention given to this problem. However, adopting this VIQ with its focus on longer-term Soviet R&D activities implies a tentative judgment** that the proposed enterprise is of sufficient importance and promise to command IC resources that are presently devoted to more immediate and short-term concerns."

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* The acronym VIQ stands for "Very Important Question." The entire question--as stated by the Defense Science Board--is provided in Attachment A.

** Emphasis added.

The reference to the Intelligence Community (IC) suggests that the intention of the Board was to elevate this problem to a national level KIQ and seek broad community support for its resolution. An indication of higher national level attention to US RDT&E planning is the effort now in train to reestablish the Office of the Science Advisor to the President. If that is done it will--we believe--also have important implications for intelligence priorities in this area.

The question of consumer needs and priorities was also discussed with representatives of the Office of Net Technical Assessment of DDR&E and with Dr. John S. Foster, former DDR&E and presently a member of the President's Foreign Intelligence Advisory Board. These officials expressed views similar to those of the Defense Science Board. In response to a question concerning consumer needs for a year-by-year analysis of Soviet priorities and resources, Dr. Foster indicated that a detailed year-by-year examination might not even be feasible and would probably dilute the effort unnecessarily. From his point of view he would favor a comprehensive approach that would link resources, goals, programs, institutions, and technologies on a

selective year basis over an aggregate annual financial or manpower time series that could not provide such linkages.

CIA officers pointed out, however, that the need for a greater in-depth analysis did not eliminate the need for an annual time series. The annual estimate, they asserted, served another need in relation to CIA estimates of resources utilized to support other aspects of Soviet military potential. While the Panel does not fully share that belief, there is no necessary contradiction between detailed in-depth studies on a selected year basis and the use of interpolative methods to develop annual estimates that CIA may feel necessary.

In sum, there is a clearly felt need at least within the Department of Defense for a fairly ambitious effort designed to achieve an improved understanding of US and Soviet competition in science and technology in its broadest aspects--well beyond just the study of resources. Whether that need in all its aspects becomes a national priority for the Intelligence Community or remains largely a departmental DoD issue must ultimately be decided by others, but the issues involved are clearly receiving closer attention by national level consumers and a successful in-depth community attack on the problem would more than meet the Panel's minimum objective--stated in our last report--that CIA should develop a better basis for its aggregate financial estimates of Soviet military RDT&E.

Review of Past Work

We cannot claim to have looked at every intelligence study dealing with the overall assessment of Soviet RDT&E policies and resources, but--prior to discussions with consumers and producers--one Panel member spent about three weeks reviewing the principal documents issued in the past few years that attempted to assess the total Soviet effort, or some major part of it, in terms of the resources and the organizations involved. The major studies included the NIE already cited, plus numerous studies prepared by CIA, DIA, the military service intelligence agencies, the Scientific and Technical Intelligence Committee to USIB, the RAND Corporation, the Stanford Research Institute, and the Institute for Defense Analyses. Other individual studies included [redacted] 25X1 [redacted] a Department of Commerce monograph, a study undertaken by Professor Korol of MIT for the National Science Foundation, an OECD study of Science policy in the USSR, a monograph on Soviet science policy by the Center for Advance International Studies, [redacted] All in all, 25X1A several dozen documents were examined.

The objective was not to do a detailed substantive evaluation of the fine points of evidence, methodology, and results found in each of these studies, but rather to try to reach a broad perspective on the various approaches to combining statistical and other data on Soviet RDT&E within an interpretive analytical model.

The studies examined do not lend themselves to easy evaluation or comparison. While often individually imaginative and energetic, taken together they have not contributed substantially to narrowing the uncertainty surrounding the total resources going into the Soviet RDT&E effort or to developing substantial agreement on even a rudimentary model of how the RDT&E system is financed and operated.

Much of the work surveyed has leaned almost exclusively--as CIA's methodogy does--on detailed examination of a single body of data (financial or manpower or programs, for example) and one of two approaches: either analysis of aggregates or a building-block approach similar to CIA's [redacted] model of the deployed forces. The analysis of aggregative

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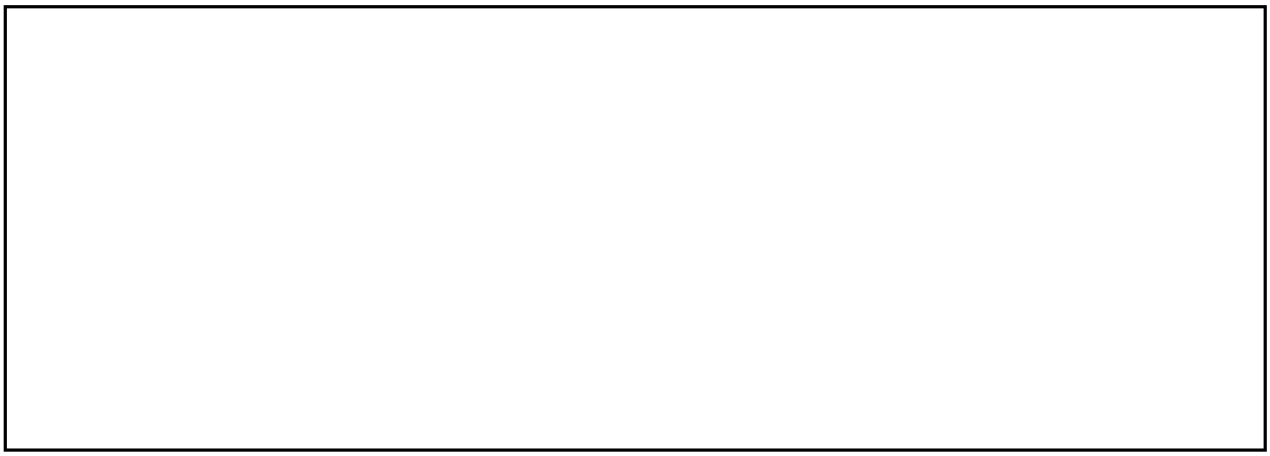
Soviet data on finances or manpower is normally limited to derivation of a total of all RDT&E and a first level disaggregation into its civilian and military components. CIA has carried this one step further by a direct costing of the Soviet space effort to arrive at one additional subaggregate. 25X1



This approach--unlike the method based on analysis of aggregate data--lends itself to analysis of mission-oriented or technology oriented military RDT&E trends.

Ideally, these two approaches should complement one another, but there are difficulties in their reconciliation. The aggregative analyses are normally done in ruble terms, based on Soviet data related to the total Soviet scientific establishment, and the building block approach is limited to military and space RDT&E

and reflects US dollar cost factors, institutions, and management styles. Without very careful work to ensure that the activities and concepts covered by these two analytical methods are comparable, reconciliation of the results can be more ambiguous than informative. If the trends are similar and there is confidence that the concepts, definitions, and coverage of the two methods can be made comparable the results may be useful in attacks on the ruble-dollar conversion problem. Moreover, to the extent that measures of resource inputs to RDT&E can be juxtaposed and evaluated along with actual RDT&E applications to new weapons programs, an improved understanding of trends in Soviet efficiency in science may become possible.

In practice, however, the trend lines obtained from the study of manpower and financial data on the one hand and from the study of observed RDT&E facilities and programs on the other have not usually been parallel. The reason for the dissimilarity in trends of the aggregative and building block approaches largely reflects the fact that Soviet programs that have not yet reached the test and evaluation stage simply cannot be calculated into the results because they are not yet recognized by US intelligence. The further back into the historical past one carries the analysis the closer the trends calculated by the

building-block approach have resembled the trends derived from the more aggregative approach. This suggests that a technique of compensation could perhaps be developed--based partly on historically derived Soviet relationships and partly on US intelligence projections of future weapons system.

The Institute for Defense Analyses has constructed another compensation technique, based on analogy with the US, which might also be combined with the two approaches mentioned above. The IDA model is computer programmed and available to CIA.*

There have been two relatively recent attempts made to combine and reconcile the results of the aggregative and building block techniques. One of these--the NIE cited earlier--was a one-time Intelligence Community effort initiated in CIA's former Office of National Estimates, but was accomplished under an unrealistically short deadline of just a few months. It did not command great agreement within the Community and there were no external pressures or internal incentives to carry the work on to further refinement.

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*A more detailed statement of the IDA model is provided in Attachment B.

The second effort to develop an overview of the Soviet RDT&E process and resource patterns was undertaken by the RAND Corporation for the DDR&E during 1970 to 1973. This was a comprehensive undertaking involving some thirty or more individual studies of different substantive and methodological aspects of US and Soviet competition in science. The effort was considerably more detailed in scope and concept than the NIE, and it came far closer to laying out a useful multi-dimensional framework for analysis. However, the effort was substantially reduced in 1973 to much less ambitious levels, before it had achieved any significant influence in the way the Intelligence Community was looking at the problem.

The reason for its lack of influence, we conclude, was because the effort was designed primarily to fill a need of the DDR&E which was not fully perceived as a need by the Community, and because it was conducted without the active participation and support of the Community. In its own words, the results were viewed as only preliminary and developmental. One Summary report of the work, prepared by Drs. Tamarkin and Schilling, states:

> "....the completed work should be considered an initial effort on a very complex problem area. ...The results may prove useful in guiding intelligence collection and analysis."

With benefit of hindsight, we feel it unfortunate that efforts along the lines laid out in both the NIE and the RAND work were not sustained and that these initial approaches did not serve to energize CIA and the Intelligence Community to attempt more comprehensive analyses in subsequent years.

The next section of our Report deals with alternatives the Agency might now want to consider in its planning for the future, and our preliminary views on the manpower required for each option. In this we will draw directly from some of the approaches and guidelines of the RAND work, which contains the most detailed elaboration so far seen of the factors that need to be considered.

Alternatives and Prospects

Our conclusion that some augmentation of CIA's work on Soviet science policy and resources is needed stems in the first instance from a perception that the level of the Soviet RDT&E effort and its significance

to the present economic and future military posture of the USSR is not now adequately reflected in the distribution of analytic effort within the Intelligence Directorate of CIA.

The more important subsidiary question of how much analytic effort to invest in the problem depends not only on the range and priority of the intelligence questions asked but on the likelihood as well that meaningful and confident answers can be derived from the available body of fragmentary and often ambiguous data.

The Panel cannot address these last points on priorities and prospects on a definitive basis, but based on this review perhaps we can comment usefully on how we view the alternatives.

As background on the alternatives available, we have elected to use the broadest frame of reference used in the various studies examined: the one developed by RAND for the comprehensive effort it undertook for the DDR&E. Following in italics is a generalized excerpt--not verbatim--drawn from the

the unclassified Overview Section of the Tamarkin and Schilling Summary Report produced at RAND in July 1972.*

To address the important questions, RAND chose to pattern the elements of the study on the RDT&E process itself. This process may be characterized as a flow of plans and activities, starting with inputs of money, educational programs, physical plant, and manpower--all working through various governmental institutions and influenced by national goals, institutional priorities and practices, specific R&D styles, and particular requirements. The outputs consist of technologies available for application in the civilian economy, space programs, for for military purposes. Another important output is the steady improvement in the scientific and technological base itself.

RAND identified for study the following facets of US and Soviet RDT&E processes appropriate for intelligence investigation:

- *--Trends and structure of monetary expenditures.*
- *--Trends in manpower training and utilization in R&D.*
- *--Compilation of Soviet RDT&E facilities and their characteristic activities.*
- *--Development of cost estimates of specific applications of RDT&E, their phasing over time, and analytis of trends.*
- *--Study of how Soviet organizations and decision-makers function in the RDT&E sector.*
- *--Interaction of Soviet with US RDT&E developments.*

* The Preface and Overview Sections of this report are provided in their entirety in Attachment C. In the above paraphrasing the military emphasis in the original has been generalized to include civilian and space RDT&E.

This simplified outline highlights the elements and processes of Soviet RDT&E that have been individually scrutinized to some degrees in the studies examined in this review and which consumers have identified as relevant to their concerns. There is some body of intelligence information available on each, but unfortunately each data set is importantly flawed either by incompleteness or by lack of precision as to the meaning it conveys. For this reason we believe that any augmented analytical effort worth serious consideration should draw together and systematically exploit as many combinations of data as possible to attempt to reduce existing uncertainties. We think the alternatives can be narrowed to two, and the CIA effort devoted to the task pegged at one of three levels.

The first alternative considered would represent a minimal augmentation of the present CIA effort--to a total of up to three analysts--to intensify and broaden the Agency's present concentration on a quantitative financial assessment of overall Soviet RDT&E and its three major subaggregates: military, civilian, and space. This option (Option I) would call for more intensive study of financial and manpower data and the open Soviet literature on how the Soviet science

establishment is managed, staffed, and financed. It would also--by virtue of the additional manpower--be able to draw more profitably from classified human sources for clarification of ambiguities in the open literature and be in a better position to evaluate and utilize work done elsewhere in the community and in non-governmental institutions. While such an effort would be more broadly based and more intensive than the present CIA effort, in our view there are good arguments against selecting this course of action:

--There is considerable doubt that this approach would in itself lead to persuasive and confident results even within the limited estimative goals sought. Numerous scholars in and outside of government have concentrated their efforts for years on such data and there still exists wide disagreement among them on the results.

--This approach would rule out the use of a potentially valuable body of information from technical collection programs which could not only provide considerable detail on the last five of the RAND list of facets of RDT&E worthy of study, but might also assist in narrowing the uncertainty of the more aggregative financial measures.

--This level of effort would not allow CIA to draw from its investment and experience in a building block approach to develop its application to Soviet RDT&E, nor permit initiatives in improving the methodological underpinning for analyses of growing interest to consumers.

We see no really satisfactory alternative to the above other than a much more intensive effort along the lines followed by the RAND studies. This implies a manpower intensive long-range investment of intelligence resources. CIA could approach this task in one of two ways, either through an independent in-house program (Option II), or by sponsoring and guiding a disciplined, shared work program within the wider Intelligence Community (Option III).

The advantages of Option II-the autonomous CIA program--lie principally with the ease of management of the effort within a single organization. Ideally, we would prefer this approach, but in the real world of constrained manpower and conflicting priorities it may not be possible.

The arguments against Option II are:

--The costs would be high and much of the effort would be duplicative of work being pursued in other components of government. Taking as a rough guide the approximate manpower inputs now going to related analyses in the community we would suppose it would take some 15 to 20 full time analysts to assemble and analyze the available data, guide collection, and produce reports.

--The judgment on the potential payoff for this high investment is still uncertain. We concur with the Defense Science Board statement that adopting the multi-dimensional approach involves merely "a tentative judgment that the proposed enterprise is of

sufficient importance and promise to command IC resources that are presently devoted to more immediate and short-term concerns."

--Such a high investment by CIA may not be necessary, providing the Agency is willing to augment its present efforts by 6 to 7 analysts and undertake serious initiatives in sponsoring and supporting a common Community effort.

This leads to our third--on balance the preferred--option, which is that CIA's effort be augmented and staffed so as to enable it to play a central role in coordinating and integrating the work of the Community as a whole on this elusive subject of Soviet science policy and resources and its role in relation to US and Soviet national power.

While there will undoubtedly be difficulties encountered in planning and carrying out coordinated action on a Community-wide basis, such a course will ensure that all areas of controversy are exposed and explored and--with the full participation of all interested departments and agencies--a wider acceptance of the results than has heretofore been the case may be realizable.

Within CIA, both DDI and DDS&T elements will need to be closely involved, and CIA's Center for the Development of Analytical Methodologies can perhaps be engaged on the problem. Outside of CIA, the inventory

of Community assets includes the considerable experience and data available in DIA, FSTC, FTD, and ONI, as well as the background that exists in several private research organizations. There are existing Community coordinating and tasking mechanisms that could support a more intensive Community effort--including the Science Policy and Resources Advisory Group of the Scientific and Technical Intelligence Committee and the Joint CIA/DIA Costing Review Board. The Director of Defense Research and Engineering and the Advanced Research Projects Agency may also be willing to provide useful support from their own experience and activities, including their on-going external research programs.

There are provisos we would attach to this recommendation. First, we doubt that much in the way of results could be expected during the first year. The reason for this will become clearer when we discuss the proposed work program. Second, the effort would have maximum influence and chances of success only if the need for a closely coordinated, highly structured, and shared work-program were perceived to be necessary and were fully supported by the Chiefs and other managers of the Intelligence Community organizations.

In the next--and final--section of this paper, some brief thoughts are laid out on a proposed CIA staff and its initial work program for the Community-wide approach.

Organizing for Option III

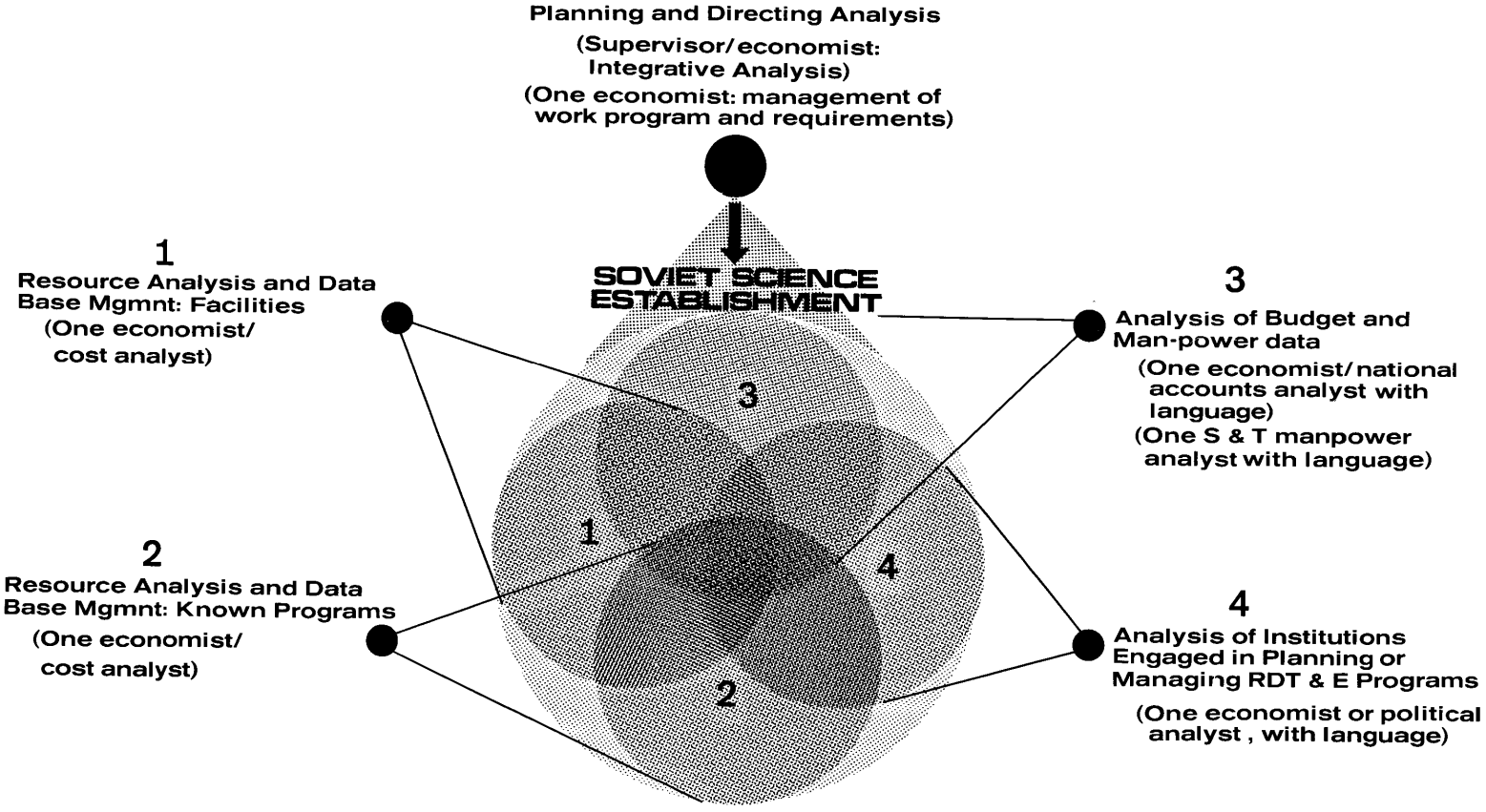
No member of the Panel has personally worked sufficiently on the broad problem under discussion for us to lay out detailed suggestions for organizing, staffing, and planning a work program. At the same time we believe the survey conducted has brought out a few clearly discernable features that need to be taken into account in planning for an augmented CIA effort, and we offer them for the Agency's consideration.

First, any staff unit given responsibility for this problem sets for itself a more than usually difficult task involving interdisciplinary analyses encompassing aspects of technology, economics, and organizational theory. Moreover, there is no well-developed and accepted analytical model available--even for the US--which could perhaps be adapted for intelligence use, and there are significant data problems. The task is made even more difficult by the recommendation--on grounds of economy--that a Community-wide approach be followed.

This strongly suggests to us that in its initial work, whatever analytical unit is established should concentrate almost exclusively at the outset on careful development and documentation of concepts, terminology, and methodology; on reviewing and improving guidance for intelligence collection and exploitation; and on establishing and nurturing the intra-Community and other governmental links so essential to an integrated work program and shared tasking. Up to four to six months should probably be allowed for this initial groundwork before much serious substantive work can be initiated. Close management attention is called for and if this Option is followed the Panel itself would like to look into the progress made at about six month intervals.

We identified a proposed staffing compliment of six to seven analysts as a tentative expression of the manpower required for Option III. Because of the complexity of the problems to be encountered, we would place greater stress on quality than quantity, and some phased build-up of the unit would probably be necessary. The chart on page 32 is meant only as an illustration of a possible distribution of effort within such a unit, along with an impressionistic view of how the various data bases and analytic techniques might interrelate with each others fields of vision.

ILLUSTRATIVE ORGANIZATION AND STAFFING PLAN (for Option III)



Finally, we would stress that however one ranks the priorities for analysis--among the military, civilian, and space aspects of Soviet RDT&E--there are both methodological and substantive reasons why the scope of the proposed effort should explicitly encompass the entire Soviet scientific establishment. Methodological because some of the analyses will be based on aggregative data, and both residualizing and building-block techniques will be necessary to bound the aggregate and define some of the sub-aggregates. And substantive because there will be questions raised concerning the interrelations among the various aspects of Soviet RDT&E: questions such as the spin-off of military to civil applications or vice versa, or of the opportunity costs of one in terms of the other.

In conclusion, we want to emphasize again that the implied shortcomings in past work to which we have called attention attach more to the overall process that has operated rather than to the individual reports and the organizations that prepared them. The individual works show serious, professional and often imaginative

approaches to the goals sought, and the shortcomings usually reflect some combination of specifically limited goals, limited data availability, and sometimes limited time. The deficiencies in the process are that the participants were often not working toward a common goal or within a comparable conceptual framework, and for this reason it sometimes appeared that they were not listening to each other.

From "Report by the Defense Science Board Summer Study Group to the Director, Defense Research & Engineering" Oct. 1982

Attachment A. Approved for use at OUO level by Maj. R.M. Foley, DDR&E (One page)

SOVIET MILITARY R&D PROCESS

1. The VIQ

What is the strategy, bureaucratic process, and resource availability of the Soviet military R&D system?

2. Rationale for Selection of this VIQ

The Key Intelligence Question process tends, quite appropriately, to focus attention on military missions or systems. However, it is widely appreciated that many weapon acquisition and development decisions are influenced by bureaucratic, financial, and organizational factors. This VIQ seeks to improve our understanding (and ability to predict) the Soviet R&D system by development a comprehensive picture or model of the entire system. Such a model must be based on analysis of the substance of Soviet scientific and technical military R&D programs as well as organizational, financial and bureaucratic aspects of these programs.

The U.S. and U.S.S.R. are involved in a continuous technology competition. Two important features of this competition are (1) the need to avoid technological surprise and (2) the long lead times (particularly in the U.S.) between development and deployment of military systems. The development of a model of the Soviet R&D system would provide a different approach to predicting the emergence of new Soviet technology and provide an important basis of assessing the technology balance between the two nations.

3. Specific Program Impact Potential

The impact of intelligence that improved our picture of the Soviet R&D process is potentially far reaching. While such intelligence should not be expected to influence immediate program choices or weapons acquisition decision, it would over time have several important indirect effects. First a more precise and thorough synthesis of the Soviet military R&D system would assist us in broadly determining the level and distribution of our R&D effects. Second, the intelligence could be influential in the U.S. techbase effects, suggesting scientific and technical areas that should be either more vigorously pursued or where emphasis should be reduced. Most importantly this intelligence approach would assume that we were taking an adequately long-term and objective view of our adversaries technical capability, productivity, and scientific interests.

4. The Essential Elements of Information needed to Answer the Question

Of course, the time horizon of interest in this VIQ extends into the indefinite future; resources should be committed to this effort up to a point where a sufficiently detailed picture of the Soviet military R&D system is formed to permit an assessment of the value of this approach. There has been some useful attention given to this problem. However, adopting this VIQ with its focus on longer-term Soviet R&D activities implies a tentative judgment that the proposed enterprise is of sufficient importance and promise to command IC resources that are presently devoted to more immediate and short-term

SECRET

ATTACHMENT B: Extract of Institute for Defens Analyses Study S-431, June 1974, 7 pages

SUMMARY

(U) This is the fifth in a series of IDA studies whose primary objective is to make comparative estimates of the magnitudes of U.S. and USSR levels of effort in military and space RDT&E.* In this study as well as in its predecessors in this series, the level of Soviet RDT&E effort is assessed by the device of estimating what it would have cost the United States, using U.S. processes, techniques, and management procedures, to develop the observed Soviet RDT&E products and then comparing that cost with actual U.S. exepnditures for the U.S. RDT&E program. In this comparison great pains are taken to apply identical cost methodologies and constraints to both sides, U.S. and USSR, so that an equitable comparison is made. The procedure is shown diagramatically in Fig. 1 and may be described as follows.

(U) The Soviet technological processes produce RDT&E products comprising aircraft prototypes, missile prototypes, nuclear warheads, first-of-class ships and submarines, etc. The U.S. intelligence collection apparatus observes (most of) these equipments and reports on their performance characteristics. IDA has compiled a set of RDT&E equipment accounts covering all known Soviet military RDT&E and space products and their pertinent performance parameters. A similar list has been compiled of U.S. equipments. However, since much more information about U.S. RDT&E programs is available to us

*The predecessors in this series were published as IDA Paper P-615 (Ref. 1), IDA Study S-384 (Ref. 2), IDA Study S-400 (Ref. 3), and IDA Study S-413 (Ref. 4).

MODEL USED BY THE INSTITUTE FOR DEFENSE ANALYSES

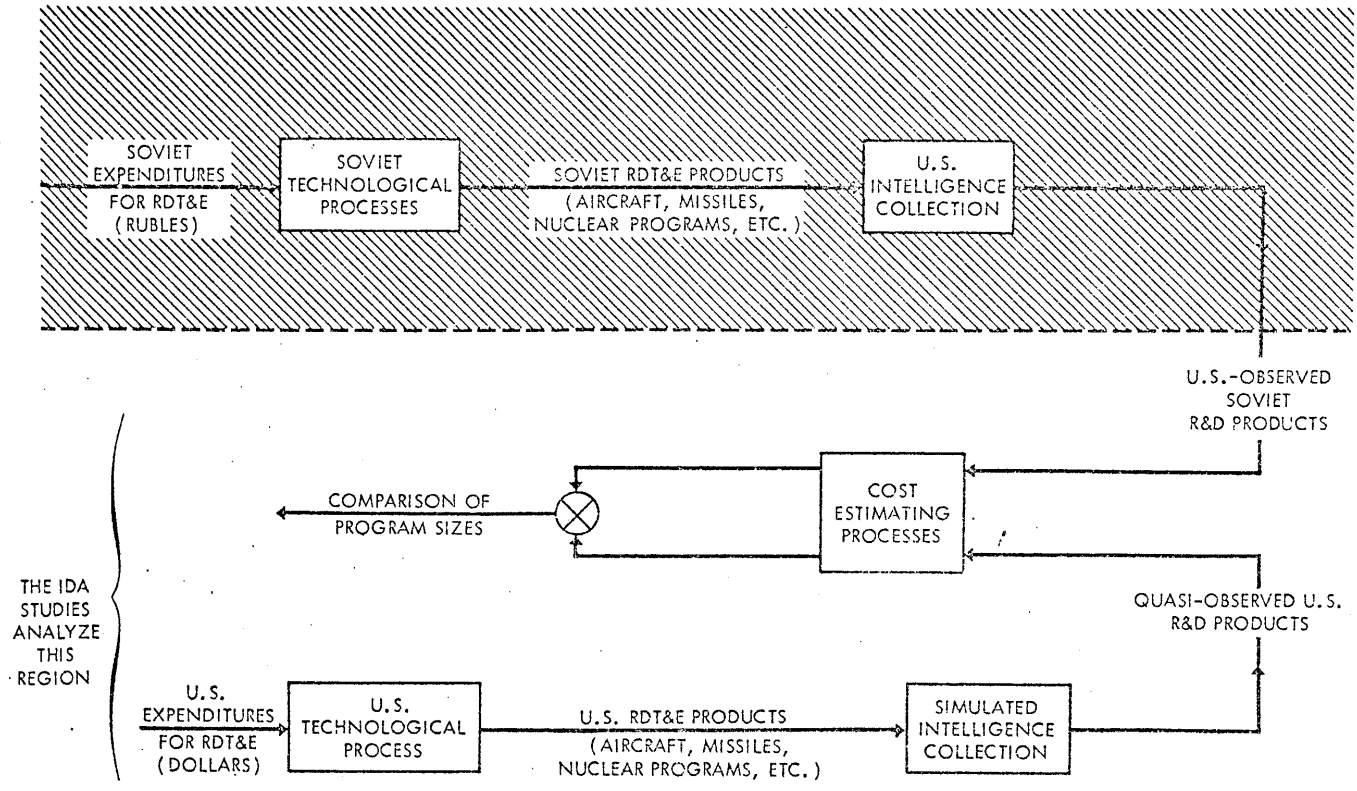


FIGURE 1 (U). Comparison of U.S. and USSR RDT&E and the Procedure for Costing Observed Products

than we can obtain about USSR programs, a filtering process simulating the same intelligence collection apparatus used on the Soviet side is applied to the U.S. data in order to make the U.S. and USSR R&D product accounts analogous and equitable. Thus, for example, although the United States has spent substantial sums for RDT&E associated with the B-1 bomber program, the B-1 has not been entered on the U.S. list of R&D products since a corresponding development on the Soviet side would not yet be observed. For each U.S. RDT&E product obtained from U.S. information sources, a judgment was made as to whether a similar item in the same phase of development on the Soviet side would be observed and reported by our intelligence collection systems. The items in these two analogous groups of R&D products, represented in Fig. 1 as "U.S.-Observed Soviet R&D Products" and "Quasi-Observed U.S. R&D Products," are costed by using identical costing methodology based on U.S. practices, processes, and management procedures.*

(U) The methodology and analytic procedures permit the following kind of conclusion to be drawn from this work: "Had the United States developed the observed Soviet R&D products, it would have cost less (or more) than it cost the United States for the products it did in fact develop." Quantitative comparisons on this basis for the individual military RDT&E and space sectors and for the total military and space programs are the subject of this report.

(U) It may bear reemphasizing that this report does not estimate Soviet ruble expenditures; it is not concerned with ruble-dollar ratios; the study results are not influenced by Soviet subsidies or other pricing or technological practices. It is not concerned with the burden of military RDT&E and space products on the Soviet

*It should be recognized that were a comparison of U.S. and USSR RDT&E programs made in terms of rubles by a Soviet analyst using Soviet processes, practices, and management procedures, the results could be quite different from those appearing in this report.

economy. It does estimate what the Soviet RDT&E program would have cost the United States, and it compares that estimate with what the United States did, in fact, spend on its own program.

(U) The intelligence data cutoff date for this report is about 1 February 1974.

(U) The findings of this study with respect to U.S. and Soviet military RDT&E and space effort are embodied in Figs. 2-4. Note that the costing of space systems in this report encompasses the total space programs of the United States and the Soviet Union.

(U) The methodology used in arriving at the estimates shown in Figs. 2-4 is described in detail in Chapter I. An abbreviated description, organized into five steps, follows.

1. (U) Establish an orderly account system; compile for each side a list of "observed" R&D products ordered by account category.

   (U) Information on the Soviet products (aircraft and missile prototypes, first-of-class ships and submarines, etc.) was obtained from the intelligence community. Lists of U.S. R&D products were obtained from classified and unclassified literature. The U.S. lists were screened to ensure that they were analogous to to the USSR lists. That is, since we wish to compare U.S. and USSR RDT&E efforts on an equitable basis, the vastly greater amount and variety of information on U.S. equipment was filtered so as to accept for cost estimating only those U.S. equipments that would have been observed, had they been Soviet, by the U.S. intelligence collection apparatus. This issue is discussed at greater length in Section I-B.

   (U) The major equipment and cost account categories used were:

   - Aircraft
   - Strategic missiles
   - Tactical missiles
   - Anti-ballistic missiles (ABMs)

- Battlefield equipment
- Naval systems
- Nuclear devices
- Space systems.

2. (U) Select a costing methodology for each account category and derive development costs for each U.S. and USSR observed R&D equipment. "Development costs" as used here refers to costs of an R&D program that result in an observable product; for example, an aircraft prototype. Other R&D cost categories, such as management and support, advanced research, and exploratory development, are treated later in this process.

(U) The preferred method of estimating R&D costs is through use of a cost estimating relationship (CER) relating U.S. cost experience to observable* output performance. An example of a CER applicable to aircraft jet engines is:

$$\text{cost} = \alpha T^{\beta} M^{\gamma} ,$$

where

cost is in billions of 1973 dollars**
T is maximum thrust in thousands of pounds
M is maximum speed in Mach number
α, β, and γ are constants.

The constants are evaluated on the basis of U.S. costs to develop this type of equipment. The CER so derived is then applied to both U.S. and USSR equipments. Hopefully, systematic errors would affect both sides equally.

(U) In some of the account categories there is insufficient information available on the Soviet side to apply a CER.

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*Or derivable from observations.

**The Fisher-Milton Cost of Research Index is used throughout this report. Cf. Section I-B.

In those instances, ad hoc methods are used; these are explained in Section I-B.

3. (U) Time-phase the development costs, compiling annual totals in each category.

(U) The estimates obtained by the processes of Step 2 above give total program costs without regard to time phasing. In practice, expenditures on these R&D programs extend over a multiyear period and will differ for each military or space sector. From available U.S. accounts, an average time-phasing schedule was derived for each category (often, for each of several subcategories) and was indexed to the year of observed initial operational capability (IOC). For each individual prototype program in each category for both the United States and the USSR, distributions of development costs were generated and indexed to their respective observed IOC dates. The costs were then summed by year. The results are shown in Fig. 5.

4. (U) Compensate for the characteristic tail-off of development costs over recent years that arises from costs of R&D programs that have not yet reached an observable state.

(U) The U.S. is currently spending substantial sums on R&D programs that have a long way to go to reach IOC; some of these programs may even be canceled for whatever good reason and not reach IOC at all. There are surely Soviet R&D programs that are similarly in early stages that we will be unaware of until about the time of their IOC. This characteristic results in a false tail-off of development costs in recent years that must be compensated. The Soviet data available for this compensation are meager. The methodology used in this report for effecting the compensation is based on trends in Soviet published time series that reflect current activity in R&D. These trends are applied to appropriate cost account categories for the period 1970-1974. The details are described in Section I-B.

On the U.S. side, compensation is effected by an identical construct using analogous U.S. statistics. The compensated curves of development costs are shown in Fig. 6.

(U) Before the final step in estimating total expenditures is taken, the significance of the penultimate finding, as shown by Fig. 6, should not be lost. The curves shown in the figure represent development costs for those systems the United States and the USSR deemed worthy of and ready for operational deployment. The discrepancy in the sizes of the two sets of programs is already clearly apparent.

5. (U) Estimate what the total U.S. expenditures would have been had development costs been those calculated for the observed USSR R&D equipments. Compare these with actual U.S. R&D expenditures.

(U) Actual U.S. annual expenditures for the U.S. military RDT&E and space programs are shown in Fig. 7 together with the compensated curve of U.S. development costs taken from Fig. 6.

(U) Examination of the data of Fig. 7 indicates that a strong linear correlation exists between the overhead costs T - D and the development costs D. The linear regression line $(T - D) = 3.8 + 0.49D$ is characterized by a correlation coefficient of 0.85. Figure 8 is a plot of overhead costs expressed as a percentage of D; i.e., $\left(\frac{T - D}{D} \times 100\%\right)$. It may be observed that the interval of values of development costs D for the USSR products lies completely outside of the D interval encompassing U.S. experience. It was therefore felt prudent to calculate expenditures based not only on the extrapolated regression line but also on an additional pair of values, one substantially smaller and one substantially larger than nominal. The overhead values 60% and 100%, shown in Fig. 8, were adopted for this purpose.

PREFACE

(U) Rand is conducting a series of component studies focused on a net assessment of U.S./USSR RDT&E programs, systems, and technologies for the Special Assistant (Net Technical Assessment) to the Director of Defense Research and Engineering, Department of Defense, under contract DAHC15-72-C-0083. The principal objective is to compare the national security expenditures and research and development programs of the Soviet Union and the United States, with special emphasis placed on those key technologies and related weapon systems that continually affect the military balance of power.

(U) The major research tasks during the past year were these:

- Comprehensive studies of the past, present, and near future economic posture of the Soviet Union and of military RDT&E expenditures, with comparisons of similar data for the United States, as related to the ability of each side to support their National Security Program.
- Specific studies involving the estimation of weapon system costs, with emphasis on those key technologies and related weapon systems that affect the military balance of power, in order to help delineate the programmatic structure of military RDT&E budgets.
- Determination and analyses of the present key technology areas that will most critically affect the near-term military capability of both the Soviet Union and the United States.
- Literature searches to determine Soviet allocations and costs of manpower, manpower utilization in R&D facilities, and aspects of training.
- Suggestions on where U.S. defense R&D might be directed to accomplish U.S. national objectives in the light of Soviet RDT&E practices, accomplishments, and trends.
- Short-term special-assistance studies and analyses on various specified topics.

(U) Results of the analytical and methodological studies conducted under this contract have been published in a series of 25 documents that are cited in the text. In addition, two summary documents were prepared in October 1971 and in February 1972 to provide an overview of the activities, progress, and interim findings. It is the purpose of this present summary report to discuss briefly, as a guide to the more complete documentation, the principal objectives and highlights of the research results of this assessment program.

ACKNOWLEDGMENTS

(U) The principal contributors to these net assessment studies were B. Augenstein, A. S. Becker, E. Brunner, Jr., D. Dreyfuss, F. W. Ermarth, T. B. Garber, W. D. Gosch, O. Hoeffding, S. Kassel, R. Knight, S. Koslov, G. S. Levenson, A. W. Marshall, A. E. Nimitz, E. W. Paxson, G. F. Schilling, and P. Tamarkin. Substantive research and evaluations were also contributed by other staff members, especially A. J. Alexander, D. Anderson, Jr., M. E. Arnsten, C. F. Black, I. S. Blumenthal, H. J. Boissevain, C. H. Builder, C. Cohen, P. M. Dadant, M. E. Davies, S. H. Dole, E. C. Field, R. E. Finch, G. H. Fisher, C. L. Freeman, V. Gilinsky, A. J. Harman, E. D. Harris, E. C. Heffern, R. Hess, J. R. Hiland, R. O. Hundley, V. G. Jackson, T. F. Kirkwood, J. D. Mallet, J. J. Mate, Jr., G. Mills, R. L. Perry, B. C. Potts, A. I. Robinson, H. S. Rowen, G. Sears, H. Shulman, G. K. Smith, F. A. Tatum, P. T. Van Dyke, J. P. White, R. A. Wise, and E. R. Zilbert.

I. OVERVIEW

RDT&E AND NET ASSESSMENT ISSUES

(U) Military RDT&E in the United States today is constrained from within and challenged from without. Internally, RDT&E budgets for defense have experienced the constraints placed on the overall defense budget as a result of the reordering of national priorities--constraints that have caused, on the average, a decrease in military RDT&E budgets since the mid-1960s in terms of constant dollars. This decrease has occurred during a period of increasing weapon system development costs. The combined effect has been to limit, more severely than in the past, the number of systems that could be developed under existing acquisition policies and RDT&E practices.

(U) Externally, military RDT&E faces the challenge of Soviet weapon development. The Soviet Union has been increasing its spending in military-space-nuclear RDT&E.* It now appears that the expenditures, looked at through the prism of relative U.S. costs, may roughly equal or even exceed our own. The result of this increased spending over the past decade has been a growing number of weapon systems--their large ICBM and naval forces are familiar examples. Moreover, it appears that in many important dimensions the Soviet scientific and technological base, the source of their weapon systems, now equals that of the United States.

(U) These contrasting trends of Soviet and American outlays on military and space RDT&E, the advance of the Soviet technology base, and the increased sophistication of their weapon systems have caused great concern in the U.S. government. The increasing Soviet effort to develop

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*(U) The rate at which Soviet outlays on defense-space RDT&E have grown was especially great for the first half of the 1960s, although the growth rate has recently shown signs of slowing down. Retardation may continue, but it is possible that the growth of expenditures will keep pace with the expansion of aggregate material outputs, now running at roughly 4 or 5 percent per year. In contrast, prospects for sustained increases in U.S. spending in the same area are at best uncertain.

their military capabilities and potential has brought about virtual parity of military power between the United States and the Soviet Union. If continued, the technological growth may well lead to the appearance of advanced new weapon systems--weapons with no adequate U.S. counterparts or defenses. This potential threat to our national security persists in the face of the strategic arms control limitation talks (SALT). Current agreements mainly affect certain procured and deployed weapon systems; the implications of these and similar future agreements for military RDT&E are not clear. However, it is unlikely that Soviet military research and technology could ever be monitored and controlled closely enough to dispel the uncertainties that are bound to persist as to R&D links with potential weapon development.

(U) With the continuing decrease in the degree of superiority in military capability that the United States has possessed relative to that of the Soviet Union and the emergence of near or actual military parity, prudence dictates increased efforts in monitoring and assessing the balance of military power. Fairly recently, U.S. net assessment activities have begun that emphasize force structures and overall programs (rather than focusing on individual systems only) and include considerations of political and economic factors affecting the military balance.

(U) This report is concerned with one such determinant of military capability and power--a comparative assessment of U.S. and Soviet military and military-related RDT&E processes. We expect that the results of this continuing comparison of RDT&E programs and activities will contribute suggestions that may help guide the programming, budgeting, and conduct of military RDT&E in the United States. The results may prove useful in guiding intelligence collection and analysis.

THE RAND COMPARATIVE ASSESSMENT STUDY

(U) The study addresses such major questions as the following:

- Have the Soviets overtaken us in the establishment of a technological base and in applications therefrom to weapon systems?

- Are we falling behind? If we are, how may our status be described, and what are the causes? Are the Soviets devoting more resources or are they more efficient than we? Is their system of RDT&E planning and decision-making more effective than ours?
- Will the Soviet programs continue to grow? If so, what directions are they likely to take, and what are the likely consequences?

To address these questions, we have chosen to pattern the elements of the study on the RDT&E process itself. This process may be characterized as a flow of plans and activities. Starting with inputs of money, facilities, and manpower at various institutions, work proceeds influenced by institutional practices, the general style of R&D acquisition, and customer requirements. In the military case, the outputs of the process broadly consist of developed weapon systems and an improved scientific and technological base. Continued refinement of this base increases a nation's capability to produce, test, and evaluate improved or entirely new weapon systems. This contribution to national security is the central purpose of conducting military RDT&E, disregarding ancillary benefits to the civilian economy from an improved technological base.

(U) The Rand study undertakes comparative assessments of the following U.S. and Soviet facets of RDT&E processes:

- Trends and structure of monetary expenditures.
- Trends in manpower training and utilization in R&D.
- Compilation of Soviet RDT&E facilities and their characteristic activities.
- Status, characteristics, and style of application of various segments of the technology base to weapon systems.
- Weapon system cost estimates and time-phased costs of the major weapon systems.

- o Functioning of Soviet organizations and decisionmaking elites in the defense and defense-related RDT&E sector, with extensions to the civil side of the sector.
- o U.S. and Soviet weapon system characteristics.
- o U.S. military RDT&E strategy and its interaction with Soviet RDT&E developments.

(U) In addition, we have studied the problem of how to develop methods to measure the "worth" of military RDT&E.

(U) We made special attempts to obtain specific economic cost data that would reflect the true military RDT&E expenditures of the USSR. In this context, in addition to utilizing the open literature, we surveyed and analyzed portions of the relevant intelligence data base, continuing the work described in WN-7631-DDRE. While this attempt did provide a very limited amount of useful data, it confirmed an earlier judgment (WN-7630-DDRE) that some reorientation of intelligence data collection would benefit all subsequent DOD net assessment efforts.

(U) We found it necessary to undertake this multidimensional examination of RDT&E processes to address properly the questions posed earlier. For example, even if available, accurate knowledge of Soviet budget, manpower, or facility allocations, taken separately or together, would provide little insight into the numbers and characteristics of weapon systems developed. Conversely, detailed knowledge of the weapon systems would provide very uncertain information about either the size of the effort needed to develop these systems or the burden placed on Soviet resources. The institutional and decisionmaking environment of Soviet military RDT&E must be explored to understand the nature and kinds of choices the Soviets made in developing their weapon systems and to permit prediction of the likely course of future military RDT&E. Examination in parallel of the same facets of the U.S. RDT&E process should give us insights into where improvements are necessary and how they might be made.

(U) Another reason for undertaking a multidimensional analysis is the fragmentary nature of information available on the Soviet aspects

of military RDT&E. In the face of the resulting uncertainties, it was necessary to examine several facets to insure consistency within the overall perspective of the RDT&E process.

(U) Because of limited resources and the need to establish priorities, we were not able to examine all facets of the RDT&E process with the intensity they deserve. Generally, we have attempted to provide breadth in the areas mentioned, perhaps at the expense of greater depth of investigation of narrower issues. We have concentrated more on Soviet than on U.S. RDT&E activities. The research on Soviet activities has focused mainly on the economics of Soviet RDT&E and on the estimation of weapon system development costs. Lack of relevant information has caused estimates to be presented in terms of U.S., rather than Soviet, resources. Continuing efforts toward a better understanding of the relationship between manpower issues and the conduct of R&D are necessary. Also needed is an extension of work on institutional practices and decisionmaking processes to increase our predictive capability as to future RDT&E developments and their implications for costs and resource allocations.

(U) For these and other reasons, the completed work should be considered as an initial effort on a very complex problem area. During the conduct of the work that is summarized here, it has become clear that some new directions and emphases would be desirable in further RDT&E net assessment efforts:

- Increased attention should be given to U.S. military RDT&E strategy to develop policies for U.S. efforts in the light of Soviet developments, current economic and military trends, and implications of both initial and future SALT negotiations and agreements. This implies increased attention to U.S. military RDT&E processes.
- More emphasis is needed on systematic comparisons of technology bases,* on the Soviet style of technological application, and on explanations for their style.

*(U) By "technological base" we mean the body of scientific, engineering, and prototype knowledge (extending to aspects of production)

- Increased attention should be devoted to developing methodologies to establish explicit input-output relationships, such as the degree of force modernization achieved by RDT&E efforts, the implications of trade-offs between the adoption of advanced technology and the accumulation of numbers of weapons, and other aspects of the "worth" of RDT&E.

(U) Descriptions of the analyses and the most important findings made during the year are summarized in the following sections of this report. More detailed information may be found in the series of documents generated by the study; they are listed in Sec. III. It should be pointed out that many of the findings of these documents are tentative and are subject to further refinement.

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that has been developed by a country and acquired from outside the country. These portions of the knowledge for which know-how has been developed--which have become well-understood and validated, for example through experimentation and use--are available for application to user needs. The amount of knowledge and know-how in the technological base increases with time (in technologically oriented countries). The total *stock* to draw upon at any time is very important. In addition, the *rate* at which new knowledge is acquired (added to the base) is at least as important. The rate at which this expansion of knowledge and know-how occurs depends on factors internal to the base (e.g., the state of scientific knowledge) and, as importantly, on external economic factors and user requirements.